DEVELOPMENT OF SOFTWARE TOOL FOR PRODUCTION PERFORMANCE ANALYSIS

LENA BT AB. SAMAT

MECHATRONIC
INDUSTRIAL ELECTRONIC
GERMAN MALAYSIAN INSTITUTE

MARCH 2003

" I hereby declare that the project paper or thesis has been read and I have the opinion that the project paper is appropriate in terms of scope coverage and quality as a thesis for a degree of bachelor of Technology (Mechatronics) "

Signature :

Project Supervisor : Mr. Chin

Date : 11/3/2003

DEVELOPMENT OF SOFTWARE TOOL FOR PRODUCTION PERFORMANCE ANALYSIS

3 BTL-00-2

LENA BT. AB. SAMAT

PROJECT SUPERVISOR
MR. CHIN S.K

BACHELOR OF TECHNOLOGY(MECHATRONIC)
GERMAN MALAYSIAN INSTITUTE

MARCH 2003

I hereby declare that this thesis is originated from my idea and is free of plagiarism

Signature :

Name : LENA BT. AB. SAMAT

Date : MARCH 2003.

To my beloved,

Father(Ab. Samat b. Bachik) , mother (Mariam bt. Surip)

And all my sister and brother, for their encouragement and unfailing support.

ACKNOWLEDGEMENT

Alhamdulillah, with Allah blessing and willing, this thesis finally of bachelor are completed.

I would like to express my heartfelt gratitude thanks to my supervisor, Mr. Chin S.K for all his guidance and academic support during the preparation of this project. I am also extremely grateful to all lecturer of department Industrial Electronic for their encouragement and helpful discussion in carrying out this project.

Now, I would like to thanks to my entire friend for their continuous support. Lastly, I wish to thanks to my beloved parents and all my sister and brother whom have the confidence on me to overcome all the obstacles in my journey to success.

DEVELOPMENT OF SOFTWARE TOOL FOR PRODUCTION PERFORMANCE ANALYSIS

Keywords: OEE, NEE, MTBA, MTBF, MTTR, MTBTF

ABSTRACT

The project describes the development of application software tool for production performance analysis. The application software tool is designed with the features of graphical user interface, which is user-friendly environment. The application software tool is enabling to compute the OEE, NEE, Uptime and Downtime, MTTR, MTBF, MTBA, MTBTF of the equipment in the production operation. The correlation studies were done to analyze the relationship of the significant factors with the OEE of the equipment in the production operation. Performance of the equipment in the production is dependent on the TSS, TSB, TEN, TFSD, TESD, TSSU, TFUD and TEUD. Prediction on breakdowns and preventive maintenance scheduled could be done with the MTBA and MTBF. The software tool data is gathered from Microsoft Excel format with applicable for all windows user.

TABLE OF CONTENT

2.0 METHODOLOGY

3.0 DEVELOPMENT OF SOFTWARE TOOL

LIST OF TABLES

LIST OF FIGURES

FIGURE	TITLE	PAGE

LIST OF SYMBOLS AND ABBREVIATIONS

OEE	-	Overall Equipment Effectiveness
NEE	-	Net Equipment Efficiency
MTBA	-	Mean Time Between Assist
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time Between Repairs
MTBTF	-	Mean Time Between Total Failures
TSS	-	Shortstops Time
TSB	-	Stand-By Time
TFSD	-	Non-Equipment related TSD
TESD	-	Equipment related TSD
TSSU	-	Set-Up Time longer than 6 minutes
TFUD	-	Non-Equipment related TUD
TEUD	-	Equipment related TUD
TEN	-	Engineering Time
TPN	-	Production Time
TPR	-	Processing Time
PET (Act)	-	Process Equipment Throughput
NEP	-	Net Equipment Productivity
A	-	Assists
F1	-	Failures non-equipment related
F2	-	Failures equipment related
CUSUM	-	Cumulative Sum
VIs	-	Virtual Instruments
DA	-	Die Attach
WB	-	Wire Bond
PS-EMS	-	Product Statistic-Equipment Monitoring System

CHAPTER 1.0

INTRODUCTION

1.1 OVERVIEW

Every factory in this world are focusing on quality improvement as a method of increasing competitiveness and achieving improved business performance. In order to improved the quality of the product, the factory attempts to be an effective whereby they should maintain high level productivity with excellent quality at low cost. Overall equipment effectiveness (OEE) began to be recognized as a fundamental method for measuring production or plant performance in the late 1980s and early 1990s by recognizing the 'hidden factory' within, whereby the improvement is done from bottom line. In other words, OEE bring us better understanding how well manufacturing area is performing and identify what factors would be limiting the production to achieve a higher effectiveness.

1.2 RATIONALE

Overall equipment effectiveness (OEE) is a measure used in Total Productive Maintenance (TPM) to calculate the percentage of actual effectiveness of the equipment. It's taking into consideration the availability of the equipment, the performance rate when running and the quality rate of the manufactured product measured over a period of time. Measurement of the machine OEE will allow the operator/maintainer core TPM team, Peter Willmott and Dennis McCarthy (2001) to focus their efforts on prioritizing and then attacking the classic six losses, which affect the machine OEE that are:

1. Breakdowns and unplanned plant shut down losses
2. Excessive set-ups, changeovers and adjustment (because the equipment is not organized)
3. Idling and minor stoppages (Not breakdowns, but requiring the attention of the operator)
4. Running at reduced speed (because the equipment 'is not quit right')
5. Start up losses (due to breakdowns and minor stoppages before the process stabilizes)
6. Quality defects, scrap and rework (because the equipment 'is not quit right'

In order for the production and equipment in the production to be an effective, it needs to have historical data about equipment failure. It's included the types of failures, the frequency of failures, and also the root causes of the failures. Accurate data on the equipment failures causes is very important before any adjustment or action is taken. Without this data the equipment performance is only base on guesswork. There can be no guess working root cause analysis because costly mistake will be made. In other words, the insufficient equipment failure data can limit the production to achieve a higher effectiveness. By doing some analysis to the classic six losses, which affect the machine OEE, the maximum efficiency and effectiveness for the production can be achieved.

1.3 PROBLEM STATEMENT

The long waiting time for analysis of the performance of production equipment for numerical computation and graphic plotting required an application software tool to enhanced its effectiveness and efficiency.

The scope of this project is to develop software tool for production performance analysis by using LabVIEW, whereby, this software tool enable to calculate Overall Equipment Effectiveness (OEE), Net equipment Productivity (NEE), Uptime (Tup) and Downtime (Tdn), Mean Time Between Repair (MTTR), Mean Time Between Failure (MTBF), mean time between assist (MTBA) and Mean Time Between Total Failure (MTBTF) of the equipment in the production. Correlation study is done to analyze the relationship of the factors with the effectiveness of the equipment in the production system. Knowing the MTBA, MTBF the user can make prediction on breakdowns and when to scheduled preventive maintenance for machine in production.

1.4 LITERATURE REVIEW

In 1996, Investigation has been done to a factory which is highly automated film finishing work center staffed with about 140 people. In the production, there are four similar equipment flow lines, 7 days a week, 24 hours a day. The products have different size and format. Daily meeting were held in order to review ongoing performance of the factory, which included the output quantity, flow lines availability, and equipment reliability expressed as an index of the four lines.

In this production, there are automated Equipment Performance System (EPS) to gather information. The EPS system provided of all the information suggested for categories to compute a detailed OEE, including frequency of events. From this information, the graph has been plot to see the performances of the production. Figure 1-1 shows the equipment index versus output index. From graph, we can see that the output had been achieved at the end of 1995 has been carried out into week one of 1996. This Is because prototype equipment projects appeared to be successful. Then, in early 1996, the equipment improvement upgrades were migrated over all four flow lines.

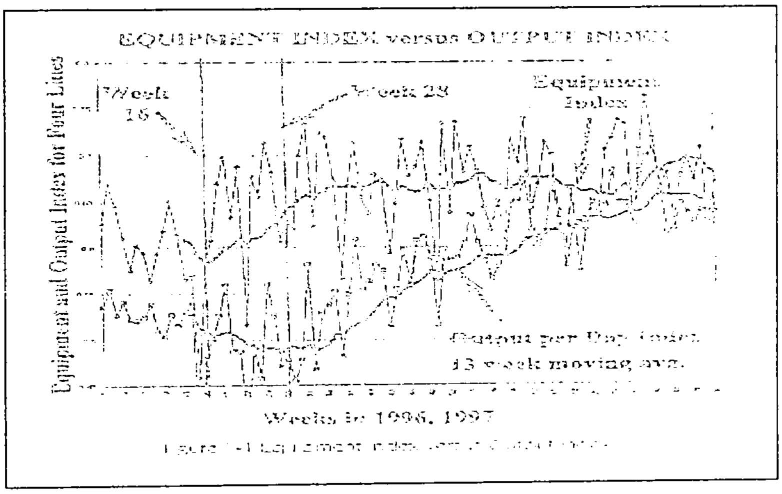

Figure 1-1:Equipment index versus Output index

Almost from week one, 1996, the output began to decline from expected level.. The result from second quarters of the year has become as serious issue when the production drops under 10 percent. By week sixteen of 1996 the investigation team had reached a conclusion.

From the investigation, they have found that the operational downtime is a root cause of the problem. After plotting Mean Time to Restore(MTTR) they identify that the many little events, which used to take 0.8 minutes to restore, were now taking 1.1 minutes. On week twenty eight of 1996, the result of the detailed investigation were shared with each crew. Some action has been taken to overcome this problem and as a result, output did reach the higher levels as predicted with the equipment modification project and the output actually correlated with the OEE of the equipment. Figure 1-2 show the Operational MTTR versus Output per day index. Therefore, the work center now makes OEE available each shift and plots the metric weekly.

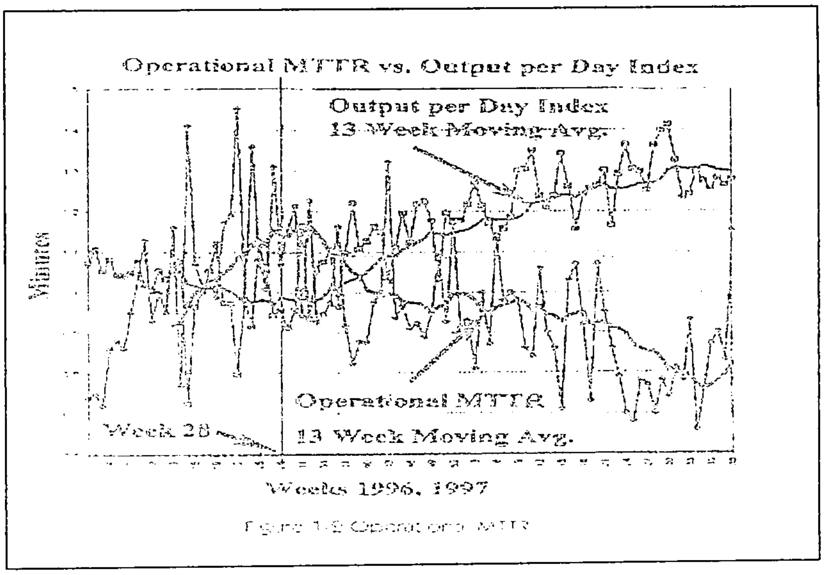

Figure 1-2: Operational MTTR

1.5 PROJECT OBJECTIVES

1. To develop A Equipment Performance Measure System application software using the LabVIEW as a software tool.
2. To compute the Overall Equipment Effectiveness (OEE), Uptime (Tup) and Downtime (Tdn), Mean Time Between Repair (MTTR), Mean Time Between Failure (MTBF), Mean Time Between Assist (MTBA), Mean Time Between Total Failure (MTBTF) of the equipment in the production operation
3. To analyze the relationship of the factors with the effectiveness of the equipment in production system.
4. To predict breakdowns and to scheduled maintenance for equipment in production.

1.6 PROJECT SCOPE

The scope of study in this project is to develop Equipment Performance Measure System application software by using LabVIEW in order to make an analysis the present effectiveness of the equipment and provide baseline for the measurement for future improvement. The software tool enable to compute the overall equipment effectiveness, the downtime and uptime of the equipment, and available to analyze the relationships of the factors with the effectiveness of the equipment in production system. By doing that, the time can be save and analysis can be done with much more easily and faster.

1.7 BACKGROUND OF THE SELECTED COMPANY

The selected company used in this project is Semiconductor Company and situated in Johore. The production was organized into highly automated machines contain several similar equipment flow lines, running at 7 days a week, 24 hour and 3 shift per day. The output is IC (Integrated Circuit), which different sizes and types. Example is IC with 8 leads, 16 leads, 24 leads and so on. The process involved in this production is

Die Attach and wire bonding process. Figure 1-3 shows one of the equipment flow line in the production. The function of each station are:

1. Input Buffer- to provide input to the Die Attach equipment. The types of input is frame which each frame contain 32 to 44 of the IC depending on the types and product running.
2. Die Attach Equipment- To Attach the Die onto the pad of the frame with correct orientation and accurate position. Must Faster than Wire Bonding equipment because its need to supply an input to the four wires bonds equipment at the same time.
3. Oven – Oven is used to heat up the glue to make sure the Die is properly attached to the pad of frame.
4. Buffer - as output storage from oven and as an input storage for wire bonding equipment.
5. Wire Bonding – To wire bond the IC.
6. Buffer – As an Output storage for wire bonding and as an input storage for the next process.
7. Conveyor track – To transport the frame to the wire bonding equipment and buffer.

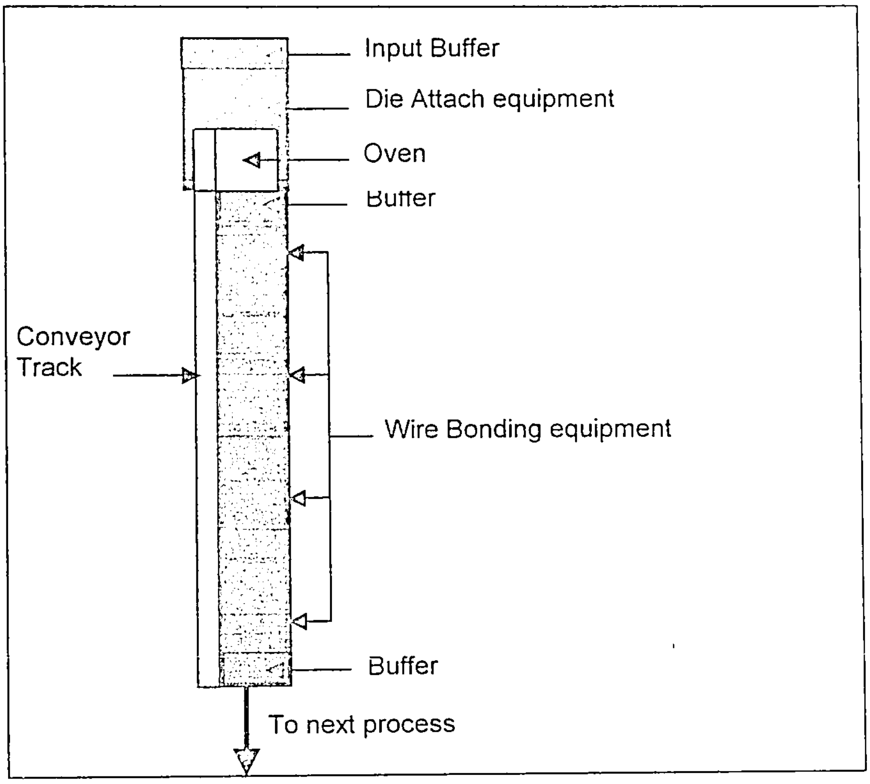

Figure 1-3: The Assembly Flow Line.

CHAPTER 2

METHODOLOGY

To carry out this project there are several step need to be accomplish in order to ensure the task is done in order. Developing the software tool for production performances analysis by using Labview will includes the following components which are data collection, Data Analysis AND result and discussion from the analysis. In this chapter, how data and what types of data need to be collect will be discuss in detail.

2.1 DATA COLLECTION

The first step in defining any problem or to identify opportunities for improvement within a process in production is to collect the data from the actual process. Before the data are taken, three preliminary steps are required which are:

Step 1: Establish the purpose for the collection of data

The purpose of collecting data in this case is to measure how effective the equipment uses in the production to produce the output so that we can know how effective the production running at the certain period of time.

Step 2: Define the type of data that are to be collected

In this project, the types of data need to be collect include various downtime causes and frequencies.

Step 3: Determine the characteristic of the data to be collected.

Data can be collected in two basic forms, which are:

1. Measurable data: Data that can be measured. Examples of measurable data are length, size, weight, height, time velocity and so on.
2. Countable data: Data that can be counted. Examples are number of defects, problem percentage of defects, problem and so on. Countable data are collected by counting the actual numbers of defects or problem produced in a given sample.

In this project, the characteristic of data to be collected is measurable data where data needed is in terms of time. But, the characteristic is changed to countable data when number of defect or problem percentage defects is collected.

2.2 METHODS OF DATA COLLECTION

In any data collection activity, accuracy is the most important aspect needs to be considered. The quality of the actions and decision taken on the data collected is good as the quality of data collected. Collection activity can be said as a GIGO, means "Garbage in-garbage out". If the quality data is good, the decision and the actions taken from the data also will be good. Conversely, if the quality of data is poor, the decisions and action taken on the data also will be poor.

One of the common tools used to collect the data is the check sheet. Check sheet allow the data to be collected in an easy way, systematic and organized manner. A variety of check sheets are used in the collection of data in the production. The most commonly used check sheet is:

1. Defective item check sheets – can be used to define the problems occurring in the department.
2. Defective location check sheets- Used to pinpoint or identify the location of certain problem or defects.
3. Defective cause check sheets- Used to identify potential causes of a problem or defect and to make adjustment to the process.